110
$$dMv/dt=E-V$$

115
$$dM_L/dt = F-L-E$$

120
$$dH_v/dt = Eh_v(T1) - Vh_v(T_v) + \phi_E$$

125
$$dH_L/dt = Fh_F - Lh_L(T_L) - Eh_V(T_L) + \phi - \phi_E$$

130
$$E=kLA(P*-P)$$

135
$$\phi_E$$
=uA (T_L - T_V)

$$140 \quad H_V=M_Vh_V(T_V)$$

$$145 \text{ H}_{L}=\text{M}_{L}\text{h}_{L}(\text{T}_{L})$$

150
$$P*=P*(T_L)$$

$$155 \text{ PV}_{V} = M_{V}RT_{V}$$

$$160 V_T = V_V + M_L/P_L$$
 .

Fig. 1 (Prior Art)

```
Mv[i]"==Fv[i]+E[i]-V[i],
Ml[i]'==F1[i]-L[i]-E[i],
Hv'==Sum[Fv[i]hfv[i]+E[i]hv[i][T1]-V[i]hv[i][Tv], {i, ncomp}],
H1'==Sum[F1[i]hf1[i]-L[i]h1[i][T1]E[i]hv[i][T1], {i, ncomp}]]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          noTnoM4={Vt==Vv+Sum[M1[i]/Rho_1[i], {i, ncomp}}]};
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         noTnoM=Join[noTnoMl, noTnoM2, noTnoM3, noTnoM4]
                                                                                                                                                                                                                                                                                                                               ncomp}],
                                                                                                                                                                                                                                                                                                                         Hv==Sum[Mv[i]hv[i][Tv], {i, ncomp
Hl==Sum[Ml[i]hl[i][Tl], {i, ncomp
Psat[i]==Pl[i][Tl],
PVv==Sum[Mv[i], {i, ncomp}]] RTv};
                                                                                                                                                                                                       E[i] == klA(Psat[i] - P),
                                                                                                                                                                                                                                       QE == uA (T1 - Tv) \};
                                                                                                                                                                                                                                                                                                 noTnoM3={
noTnoM1={
```

$$\begin{aligned} \phi_E &= 0 \\ H &= H_L + H_V \\ T &= T_L = T_V \end{aligned}$$
 Fig. 3

$$M=M_L+M_V$$
 $P_T=P*=P$
Fig. 4

$$M_V = 0$$
 $M = M_L$
Fig. 5

Fig. 7

 $\text{H'} == \text{N+} \sum_{i=1}^{\text{ncomp}} \text{F1[i]hf1[i]} - \sum_{i=1}^{\text{ncomp}} \text{L[i]h1[i]} \left[\text{T]} + \sum_{i=1}^{\text{ncomp}} \text{Fv[i]hfv[i]} \right]$

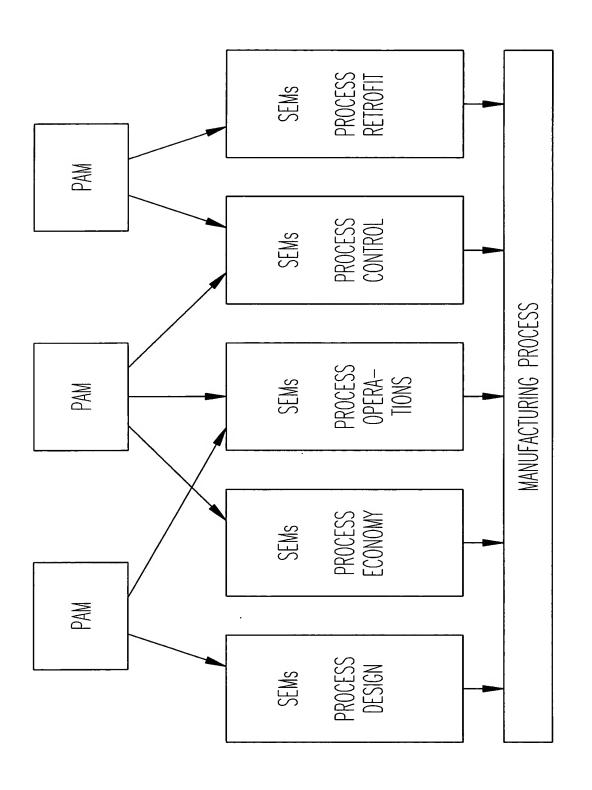
M[i]' ==FI[i]+FV[i]-L[i]-V[i]

 $H==\sum_{i=1}^{n\text{comp}}M[i]-0hl[i][T]$

 $dH/dt = Fh_F - Lh_L - Vh_V + \phi$ $H = Mh_L (T)$

dM/dt=F-L-V

H19.6



P19.8

```
i - index for components (1, . . ., ncomp)
j - index for trays (1, . . ., ntray)
Reboiler (tray 1)
                                                                                                                                                                                                                                                                                                           in [399]:= NoThermalNoMaterial = True;
                                                         ■Distillation column
                                                                                                                                                                                                                                                                                                                                                                           VaporHoldUp = True;
SingleComp = False;
Flash = False;
SteadyState = True;
                                                                                                                                                                                                                                                                   ■ Specifications/Assumptions
                                                                                                                                                                                                                                                                                                                                                      Material = False;
                                                                                                                                                                                                                                                                                                                                   Thermal = False;
                                                                                                                                                                           Condens er (tray ntray)
Feed (tray nfeed)
```

F19.9

```
 \begin{aligned} &V[i][j]\mathring{h}^{\nu}(i][T\nu[j]] + V[i][j-1]h\nu[i][T\nu[j-1]])\,,\\ &ncomp\\ 0 = &Q[j] - QE[j] + \sum &(Fl[i][j]hfl[i][Tf[j]] - L[i][j]hl[i][Tl[j]] - \\ \end{aligned} 
                                                      Out [435] = \{0 == e[i][j] + Fv[i][j] + V[i][-1+j] - V[i][j],
0 == -e[i][j] + FI[i][j] - L[i][j] + L[i][1+j],
ncomp
0 == QE[j] + \sum_{i=1}^{n} (Fv[i][j] hfv[i][Tf[j]] + e[i][j] hv[i][TI[j]] -
                                                                                                                                                                                                                                                                            e[i][j]hv[i][Tl[j]]+L[i][j+l]hl[i][Tl[j+l]]),
e[i][j]==Akl(-P[j]+Psat[i][j]),QE[j]==Au(Tl[j]-Tv[j]),
ncomp
Hv[j]== \sum_Mv[i][j]hv[i][Tv[j]],
i=1
ncomp
Hl[j]== \sum_Ml[i][j]hl[i][Tl[j]],
i=1
Psat[i][j]==Pl[i][Tl[j]],
fncomp
P[j]Vv[j]==R \sum_{i=1} \sum_Mv[i][j]],
i=1

                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Rho_1[i][T1[j]] +Vv[j]]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   Ml[i][j]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              Vt[j] == \sum_{j=1}^{ncomp}
```

Hig. 10